

## CLAIMS

1. A heating apparatus comprising:

- 5 – generating means for generating electromagnetic radiation at a wavelength  $\lambda$ ,
- a waveguide for guiding the generated electromagnetic radiation to a waveguide applicator for holding a sample to be heated, the sample having dielectric properties  $\epsilon_{\text{sample}}$  which varies as a function of a temperature of the sample, the waveguide and
- 10 the waveguide applicator supporting a single transverse mode,
- a deflector formed by a closed loop defining a plane, said deflector having an inherent resonance frequency  $\nu_{\text{defl}}$  and a thickness in the interval  $[\lambda_{30}; \lambda_d]$  in a direction normal to said plane, the deflector being rotatable around an axis being at least substantially
- 15 parallel to said plane,
- the deflector being positioned in the waveguide so as to form a resonant cavity with the sample and the waveguide applicator, said cavity having at least one resonance frequency  $\nu_{\text{cav}}$  being dependent upon at least  $\epsilon_{\text{sample}}$ ,  $\nu_{\text{defl}}$ , and an angle of rotation of
- 20 the deflector,  $\alpha_{\text{defl}}$ .

2. An apparatus according to claim 1, wherein the deflector deflects at least part of the guided electromagnetic waves so as to determine a coupling of the guided waves from the waveguide to the waveguide applicator.

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3. An apparatus according to claim 1, wherein the deflector has a thickness in the interval  $[\lambda_{20}; \lambda_{10}]$  in a direction normal to the plane of the deflector.

4. An apparatus according to claim 1, wherein the deflector is shaped like an ellipse

30 having a major principal axis  $a$  and a minor principal axis  $b$ .

5. An apparatus according to claim 1, wherein the deflector is shaped like a trapezium, such as a rectangle having a width  $a$  and a height  $b$ .

6. An apparatus according to claim 1, further comprising a member of a material having a relative permittivity larger than 5, such as larger than 10, preferably larger than 25 positioned within the waveguide applicator for adjusting the resonance frequency of the cavity and/or the coupling of the guided waves between the waveguide and the  
5 waveguide applicator.

7. An apparatus according to claim 6, wherein the material of the member comprises ceramic materials comprising one or more materials selected from the group consisting of  $\text{Al}_2\text{O}_3$ ,  $\text{TiO}_2$  or  $\text{XTiO}_3$ , where X is any group II element such as Ca or Mg.  
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8. An apparatus according to claim 6, wherein the relative permittivity and/or the shape and/or the size of said member is chosen so as to make the cavity resonant at a predetermined set of conditions such as the sample volume, the sample permittivity, and the coupling of the guided waves between the waveguide and the waveguide applicator.  
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9. An apparatus according to claim 1, further comprising means for adjusting the position of the sample in the waveguide applicator in order to adjust the resonance frequency of the cavity and/or the coupling of the guided waves between the waveguide and the waveguide applicator.  
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10. An apparatus according to claim 9, further comprising supporting means for supporting a container holding the sample, wherein the means for adjusting the position of the sample comprises means for adjusting a substantially vertical position of said supporting means.  
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11. An apparatus according to claim 1, further comprising a first circulator and a first dummy load, said first circulator being adapted to deflect at least part of electromagnetic radiation reflected from the applicator towards the first dummy load.

30 12. An apparatus according to claim 1, further comprising at least one power measuring means being adapted to measure power of at least part of the electromagnetic radiation deflected from the first circulator.

13. An apparatus according to claim 12 further comprising a first memory means for  
35 storing information from the at least one power measuring means.

14. An apparatus according to claim 1, wherein the generating means comprises a magnetron.
- 5 15. An apparatus according to claim 1, wherein the generating means comprises a semiconductor based generator and a semiconductor based amplifier.
16. An apparatus according to claim 15, wherein the semiconductor based amplifier comprises one or more silicon-carbide power transistors.
- 10 17. An apparatus according to claim 1, further comprising a thermal radiation sensitive element positioned so as to receive thermal radiation emanating from the sample.
18. An apparatus according to claim 17, wherein the thermal radiation sensitive element is adapted to determine a temperature of the sample.
- 15 19. An apparatus according to claim 1, wherein the applicator comprises a protection screen for separating the deflector and the waveguide from the sample, said screen being substantially transparent to the electromagnetic waves guided towards the waveguide applicator.
- 20 20. An apparatus according to claim 19, wherein said substantially transparent screen comprises one or more of the materials selected from the group consisting of: PTFE (Teflon®) TPX, polypropene or polyphenylenesulphide (PPS, Ryton®).
- 25 21. An apparatus according to claim 1, wherein the applicator comprises a drain for draining sample from within the applicator.
22. An apparatus according to claim 1, wherein the electromagnetic waves comprises microwaves having a frequency in the interval 300MHz - 300 GHz.
- 30 23. A method for heating a sample, said method comprising the steps of:
- I. providing a heating apparatus according to claim 1 and inserting the sample in the applicator,
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II. generating electromagnetic radiation at a first output power level,

III. rotating the deflector for adjusting the coupling factor between the waveguide and the  
5 resonant cavity.

24. A method according to claim 23, wherein the sample has a first temperature  $T_1$ , the method further comprising the steps of:

10 heating the sample to obtain a second temperature  $T_2 > T_1$ ,

rotating the deflector for adjusting the coupling factor between the waveguide and the resonant cavity in response to the variation in the dielectric properties  $\epsilon_{\text{sample}}$  of the sample.

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25. A method according to claim 23, Wherein step III comprises the steps of:

IV. performing the following steps one or more times:

- positioning the deflector in a first position and measuring a first power of  
20 electromagnetic radiation reflected from the waveguide applicator, the reflected radiation corresponding to said first position of the deflector,
- rotating the deflector to a second position that is different from the first position and measuring a second power of electromagnetic radiation reflected from the waveguide  
25 applicator, the reflected radiation corresponding to said second position of the deflector, and

V. determining a preferred position of the deflector based on the amount of power reflected from the waveguide applicator in at least the first and second position.

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26. A method according to claim 25, further comprising the steps of:

VI. providing a first storing means,

VII. storing information relating to the first position in the storing means and storing the measured first power in relation thereto, and

VIII. storing information relating to the second position in the storing means and storing  
5 the measured second power in relation thereto.

27. A method according to claim 26, wherein step V comprises processing the stored measured powers for determining the preferred position of the deflector corresponding to a local or absolute minimum in the measured power or to a predetermined ratio of the  
10 measured power to the first output power level.

28. A method according to claim 25, further comprising the steps of positioning the deflector in the preferred position.

15 29. A method according to claim 25, further comprising the steps of positioning the deflector in the preferred position and generating electromagnetic radiation at a second output power level which is larger than the first output power level.

30. A method according to claim 26, further comprising the steps of determining a  
20 measure of the relative permittivity of the sample by comparing the stored measured powers with corresponding stored measured powers from a different sample.

31. A method according to claim 26, further comprising the steps of determining an indication of the chemical composition of the sample by comparing the stored measured  
25 powers with corresponding stored measured powers from a sample of known chemical composition.

32. A method according to claim 31, wherein the sample comprises at least one reactant for performing a chemical reaction, the method further comprising the steps of:  
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performing the chemical reaction with the at least one reactant, and

determining a degree of reaction for the chemical reaction using the indication of the chemical composition of the sample.